

## REMARKS

This paper is responsive to the Office Action dated Dec. 28, 2007 (“Office Action”). Claims 1–28 are pending in this Patent Application. Of these, claims 3, 5–8, 10, 11, 14, 15, 17, 20, 21 and 23–28 are withdrawn from consideration, and claims 1, 2, 4, 9, 12, 13, 16, 18, 19 and 22 were considered on the merits. Claims 1, 2, 4, 9, 12, 13, 16, 18, 19 and 22 were rejected. Claims 18, 19 and 22 were objected to.

In this Response, claims 1 and 17–21 have been amended to clarify the claimed subject matter and correct informalities. All amendments are fully supported by the specification and no new matter has been introduced. In view of the foregoing amendments and following remarks, Applicants respectfully request withdrawal of all rejections and objections.

### *Election of species*

Applicants thank the Examiner for clarifying the grounds of the restriction requirement and applying the election as formulated by Applicants during the telephone interview of Dec. 19, 2007. Applicants confirm the election of claims 1, 2, 4, 9, 12, 13, 16, 18, 19 and 22 for prosecution.

### *Objections to the claims*

Claims 18, 19 and 22 were objected to. Applicants respectfully request withdrawal of the objections for at least the reasons stated below.

Claim 18 was objected to for having the wrong dependency on claim 15 instead of claim 16. Applicants thank the Examiner for pointing out the informality, which was due to a typographic error. Claim 18 has been amended to correct the error, along with withdrawn claim 17 which included the same typographic error.

Claim 19 was objected to for failing to limit the subject matter of its parent claim 1, because the limitation of a “transition frequency” is not a structural element of the apparatus of claim 1. Applicants respectfully disagree with the objection because “an active medium, having a transition frequency” is a structural element of claim 1, and therefore a limitation on the transition frequency clearly limits the subject matter of

claim 1. Moreover, claim 19 has been amended to address the rejection under 35 U.S.C. § 112, second paragraph (see below), and Applicants believe that this amendment should also address the objection to the claim.

Claim 22 was also objected to for failing to limit the subject matter of its parent claim 1, because the limitation of an “energy source” is not a structural element of the apparatus of claim 1. Claim 1 has been amended to add an express limitation of “an energy source” as a structural element. As discussed further below, this amendment also addresses a separate rejection under 35 U.S.C. § 112.

### ***Claim rejections – 35 U.S.C. § 112***

Claims 1, 2, 4, 9, 12, 13, 16, 18, 19 and 22 were rejected under 35 U.S.C. § 112, second paragraph, as indefinite. Applicants respectfully request withdrawal of all rejections for at least the reasons stated below.

Regarding claim 1, the Office Action indicated on page 3 that the expression “an active medium, having a transition frequency” is indefinite “since it is not apparent, as to what the active medium might be, since any medium has some transition frequency.” Applicants respectfully disagree with the rejection. The objective requirement of 35 U.S.C. § 112, second paragraph, is that whether the scope of the claim would be clear to a hypothetical person possessing the ordinary level of skill in the pertinent art. MPEP 2171. The fact that a wide variety of active media having a transition frequency may be encompassed by the claim does not make it indefinite, because breadth of a claim is not to be equated with indefiniteness. MPEP 2173.04.

Regarding claim 1, the Office Action also indicated on page 3 that the expression “an active medium . . . having at least one object having significant dipole oscillator strength” is indefinite because it is not clear “whether the active medium is comprised of the objects with ‘significant dipole oscillator strength’, or this is an active medium comprised of some material, that additionally contains such objects?” Applicants respectfully disagree with the rejection. Transitional phrases such as “having” must be interpreted in light of the specification to determine whether open or closed claim language is intended. MPEP 2111.03. The specification of the present application provides

examples of the broad, open-ended structural relationship between the active medium and the objects. *See, e.g.*, specification at 10, lines 2–12. To clarify the claimed subject matter, claim 1 has been amended to substitute “comprising” for “having.” Since the amendment has only the purpose of clarification, there is no change of claim scope.

Regarding claim 1, the Office Action also indicated on page 3 that the expression “an active medium . . . having at least one object having significant dipole oscillator strength” is indefinite because “it is not apparent, as to what the ‘objects with significant dipole oscillator strength’ are, since too many molecular objects possess dipoles, and the term ‘significant’ is a relative term.” Applicants respectfully disagree with the rejection. The fact that claim language, including terms of degree, may not be precise, does not automatically render the claim indefinite under 35 U.S.C. § 112, second paragraph. MPEP 2173.05(b). When a term of degree is presented in a claim, the initial determination is whether the specification provides some standard for measuring that degree. *Id.* The specification of the present application provides examples of objects having “significant dipole oscillator strength,” such as rare-earth ions and semiconductor quantum dots. Specification at 7, lines 14–16. Since the specification provides a standard for determining the scope of the claim limitations, Applicants submit that the claim is definite.

Regarding claim 1, the Office Action also indicated on page 3 that the “wherein” clause “does not provide a clear structural limitation to the structure or the materials of the two structural elements recited in the claim.” Applicants respectfully disagree with the rejection. Functional language does not, in and of itself, render a claim improper. MPEP 2173.05(g). Applicants request the Examiner to withdraw the rejection or clarify its grounds. In particular the Examiner should explain why the functional language of the “wherein” clause fails to limit the scope of the claim.

Regarding claim 1, the Office Action also indicated on page 3 that the expression “the transition of the at least one object” is indefinite. The Office Action stated: “Where is the object transitioned? Was the expression meant to recite ‘excitation of the resonance frequency of the object’? Also, it is not clear, how transition of the object can stimulate emission of the surface plasmon?” Applicants respectfully disagree with the rejection. Transitions involving objects of an active medium are extensively discussed in the

specification of the present application. *See, e.g.*, specification at 7, lines 13–20. A transition may result from the application of an energy source. *See* specification at 8, lines 16–21. It is well known that in general, emission of any particle may also involve a transition by an emitting object, for example to provide the energy and/or momentum of the emitted particle, and more generally to satisfy conservation laws. In particular, stimulated emission of surface plasmons may involve a transition. *See* specification at 8, lines 21–24. Applicants submit that the meaning of the term “stimulated emission” is well understood in the art, for example as applied to lasers, as indicated in the specification at 8, lines 25–28.

Regarding claims 9 and 19, the Office Action indicated on page 3 that “it is not apparent, as to how the recitation of the claims further limits the structure recited in the parent claim.” As to claim 9, Applicants respectfully submit that the limitation “the resonant medium has surface plasmon modes in the visible region of the electromagnetic frequency spectrum” properly limits the structure of claim 1, which includes the structural element of “a resonant medium.” Claim 19 has been amended to further clarify the narrowing of the “transition frequency of the active medium,” which is a limitation of claim 1. Withdrawn claims 20 and 21, which include similarly worded limitations, have also been amended for consistency.

Regarding claim 18, the Office Action indicated on page 3 that “it is not clear, which type of organic molecules is meant in the claim.” Applicants respectfully disagree with the rejection. First of all, the meaning of the term “organic molecules” is well known in the art and not subject to ambiguities. Therefore the scope of the claim would be clear to a hypothetical person possessing the ordinary level of skill in the pertinent art, and thus satisfies the objective requirements of § 112, second paragraph. *See* MPEP 2171. Second, there is no legal requirement that a claim be drafted in narrow terms. The breadth of a claim is not to be equated with indefiniteness, as long as the scope of the subject matter embraced by the claims is clear. *See* MPEP 2173.04. Finally, the claim is fully supported by the specification, page 8, lines 12–15, which would allow any person skilled in the art to understand the scope of the claim.

Regarding claim 18, the Office Action also indicated on page 3 that “[i]t is further unclear, as to what is meant by the term ‘including’ in the claim. Does it recite a nanocrystal, or a nanocrystal covered with a layer of organic molecules?” The claim has been amended to address the rejection, by clarifying that the claim requires “a nanocrystal covered with a layer of organic molecules.”

Regarding claim 22, the Office Action indicated on page 4 that the claim “does not seem to relate to the parent claim, since the parent claim does not recite an optical energy source as a part of the apparatus.” Applicants believe that the amendment of claim 1 to address the objection discussed above also addresses the rejection under 35 U.S.C. § 112, second paragraph. Claim 1, from which claim 22 depends, has been amended to add an express limitation of “an energy source” as a structural element.

#### ***Claim rejections – 35 U.S.C. § 102***

Claims 1, 2, 4, 9, 12, 13, 16, 18, 19 and 22 were rejected under 35 U.S.C. § 102(a) over O. Kulakovich et al., “Enhanced Luminescence of CdSe Quantum Dots on Gold Colloids,” *Nano Letters* 2(12):1449 (hereinafter “Kulakovich”). Applicants respectfully traverse the rejection. Anticipation under 35 U.S.C. § 102 requires that each and every element as set forth in the claim be found in a single prior art reference. MPEP § 2131. Claim 1 has been amended to clarify the claimed subject matter. The amendment is fully supported by the specification, therefore no new matter has been added. *See* specification at 3, lines 24–26. Claim 1, as currently amended, includes the limitation that “the stimulated emission causes the buildup of a macroscopic number of surface plasmons in the at least one surface plasmon mode.” Applicants submit that Kulakovich does not teach, or even fairly suggest, this limitation.

The teachings of Kulakovich may be summarized as follows. The reference generally discusses the properties of a system comprising a monolayer of gold nanoparticles deposited on a glass substrate, a multilayer polymer film acting as an inert spacer, and a film of CdSe/ZnS quantum dots. Kulakovich at 1450, left column. The quantum dots were excited by 550 nm light and the photoluminescence (PL) signal was plotted against the spacer thickness. Kulakovich at 1451. Kulakovich reports a peak in the photoluminescence (PL) signal at a spacer thickness around 11 nm. *Id.* Kulakovich

explains the decrease in the PL signal at very small values of the spacer thickness by resonant energy transfer (RET) between the quantum dots and the metallic surface. Kulakovich at 1451, right column.

The Office Action indicated on page 4 that Kulakovich anticipates the subject matter of claim 1 because the gold nanoparticles are “a resonant medium having at least one surface plasmon mode therein,” and the CdSe quantum dots are “an active medium.” However Kulakovich does not even report the observation of stimulated emission, and certainly does not teach that stimulated emission “causes the buildup of a macroscopic number of surface plasmons in the at least one surface plasmon mode.” Such buildup is a signature of the effect denoted as Surface Plasmon Amplification by Stimulated Emission of Radiation, or SPASER. Buildup of surface plasmons is not possible under all conditions, but requires certain requirements to be met. One way of meeting such requirements is by satisfying the amplification condition  $\alpha_a > 0$ , as explained in detail in U.S. Provisional Application No. 60/437,760, incorporated by reference in the present application. Kulakovich does not discuss the buildup of a macroscopic number of surface plasmons, and does not teach under which conditions such buildup may occur.

Claims 1, 2, 9, 12, 13, 16, 18, 19 and 22 were rejected under 35 U.S.C. § 102(a) over K. T. Shimizu et al., “Surface-Enhanced Emission from Single Semiconductor Nanocrystals,” *Phys. Rev. Lett.* 89(11):117401 (hereinafter “Shimizu”). Applicants respectfully traverse the rejection on the ground that Shimizu does not teach, or even fairly suggest, the limitation that “the stimulated emission causes the buildup of a macroscopic number of surface plasmons in the at least one surface plasmon mode.”

The teachings of Shimizu may be summarized as follows. The reference generally discusses the properties of a system comprising a rough gold substrate formed on a silicon wafer, and CdSe/ZnS nanocrystals deposited thereon. Shimizu at 117401-1. The sample was excited by 514 nm light and fluorescence from the nanocrystals was measured. *Id.* Shimizu attributes an observed enhanced fluorescence to resonance between the dipole frequency of the nanocrystals and the metal surface plasmon. Shimizu at 117401-3. Shimizu also discusses the role of nonradiative energy transfer from the excited dipole to the metal. *Id.*

The Office Action indicated on pages 4–5 that Shimizu anticipates the subject matter of claim 1 because the rough gold film is “a resonant medium having at least one surface plasmon mode therein,” and the nanocrystals are “an active medium.” However Shimizu, like Kulakovich, does not even report the observation of stimulated emission, and certainly does not teach that stimulated emission “causes the buildup of a macroscopic number of surface plasmons in the at least one surface plasmon mode.” Kulakovich does not discuss the buildup of a macroscopic number of surface plasmons, and does not teach under which conditions such buildup may occur.

### *Conclusions*

In view of the foregoing amendments and remarks, Applicants respectfully submit that the present application is in condition for allowance. No fees are believed to be due, however the Commissioner is hereby authorized to charge any fees to Deposit Account No. 11-0980.

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Respectfully submitted,  
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